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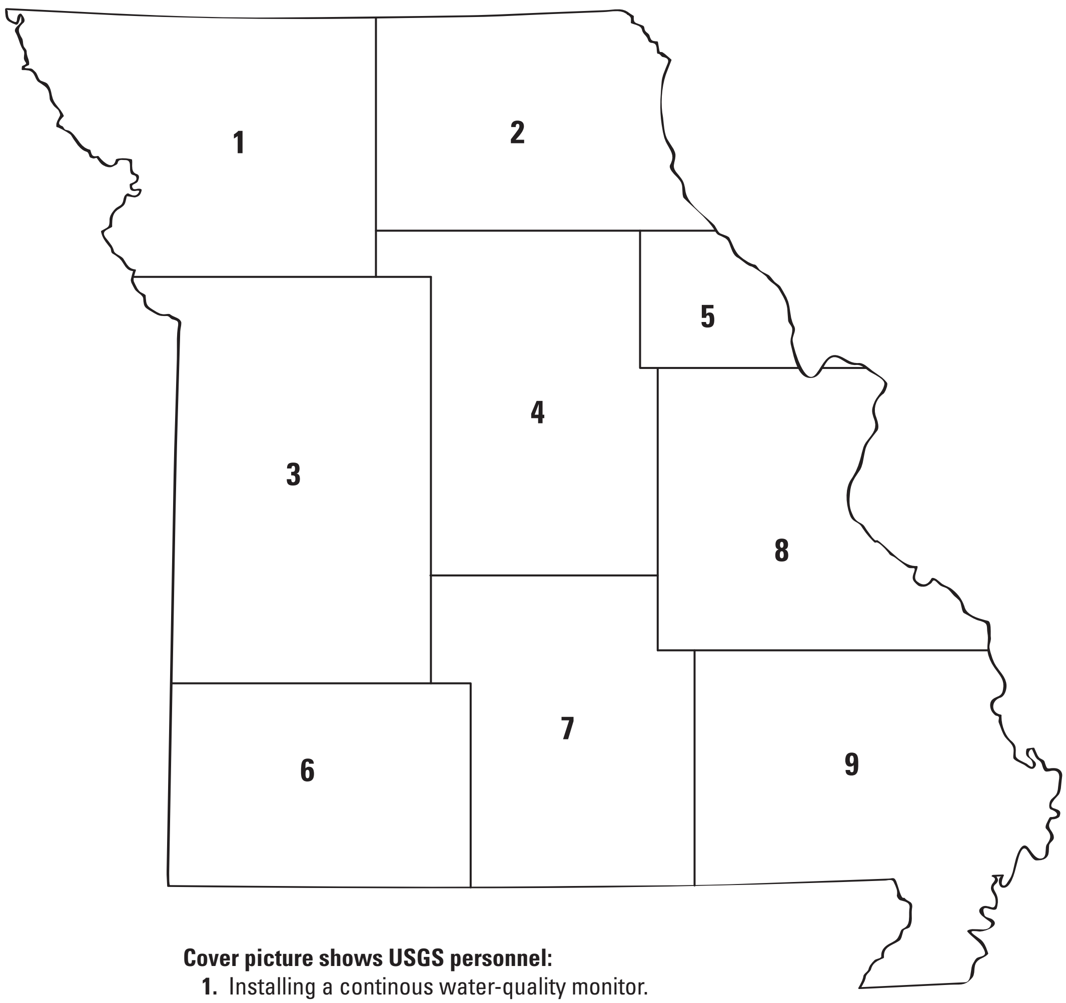
Quality of Surface Water in Missouri, Water Year 2008

Open-File Report 2009–1214

U.S. Department of the Interior
U.S. Geological Survey



Cover picture shows USGS personnel:

1. Installing a continous water-quality monitor.
2. Processing indicator bacteria plates.
3. Collecting surface water-quality sample using Equal Width Increment (EWI) method.
4. Measuring streamflow with StreamPro.
5. Servicing a continuous water-quality monitor.
6. Measuring streamflow with ADCP.
7. Measuring pH of a surface water-quality sample.
8. Collecting a surface water-quality sample for pesticide analysis.
9. Collecting a surface water-quality sample from a bridge using a D-96 sampler.

Quality of Surface Water in Missouri, Water Year 2008

By William Otero-Benítez and Jerri V. Davis

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U.S. Department of the Interior
KEN SALAZAR, Secretary

U.S. Geological Survey
Suzette M. Kimball, Acting Director

U.S. Geological Survey, Reston, Virginia: 2009

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Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
liter (L)	0.2642	gallon (gal)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32$$

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Quality of Surface Water in Missouri, Water Year 2008

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Abstract

The U.S. Geological Survey, in cooperation with the Missouri Department of Natural Resources, designed and operates a series of monitoring stations on streams throughout Missouri known as the Ambient Water-Quality Monitoring Network. During the 2008 water year (October 1, 2007, through September 30, 2008), data were collected at 67 stations, including two U.S. Geological Survey National Stream Quality Accounting Network stations and one spring sampled in cooperation with the U.S. Forest Service. Dissolved oxygen, specific conductance, water temperature, suspended solids, suspended sediment, fecal coliform bacteria, *Escherichia coli* bacteria, dissolved nitrate plus nitrite, total phosphorus, dissolved and total recoverable lead and zinc, and selected pesticide data summaries are presented for 64 of these stations. The stations primarily have been classified into groups corresponding to the physiography of the State, primary land use, or unique station types. In addition, a summary of hydrologic conditions in the State including peak discharges, monthly mean discharges, and seven-day low flow is presented.

Introduction

The U.S. Geological Survey (USGS), in cooperation with the Missouri Department of Natural Resources (MDNR), collects data pertaining to the water resources of Missouri each water year (October 1 through September 30). These data, stored and maintained in the USGS National Water Information System (NWIS) database, are collected as part of the Missouri Ambient Water-Quality Monitoring Network (AWQMN) and constitute a source of reliable, impartial, and timely information for developing an enhanced understanding of the water resources of the State. To make this information readily available, these data were published annually from water years 1964 to 2005 (U.S. Geological Survey, 1964–2005). The published data for the 2006, 2007, and 2008 water years are now available on the World Wide Web and can be accessed at *http://wdr.water.usgs.gov.*

The MDNR is in charge of the implementation of the Federal Clean Water Act (CWA) in Missouri. Section 305(b) of the CWA requires that each State develop a water-quality monitoring program and periodically report the status of its water quality (U.S. Environmental Protection Agency, 1997). Water-quality status is described in terms of the suitability of the water for various uses, such as drinking, fishing, swimming, and support of aquatic life; these uses are formally defined as "designated uses" in State and Federal Regulations. Section 303(d) of the CWA requires that certain waters that do not meet applicable water-quality standards be identified, and total maximum daily loads (TMDLs) be determined for these waters (U.S. Environmental Protection Agency, 1997). TMDLs establish the maximum amount of an impairing substance that a waterbody can assimilate and still meet the water-quality standards. A TMDL addresses a single pollutant for each waterbody.

Missouri has an area of approximately 69,000 square miles (mi^2) and an estimated population of 5.91 million people (U.S. Census Bureau, 2009). Within Missouri 22,216 miles (mi) of classified streams support wildlife, recreation, agriculture, industry, transportation, and public utilities. An estimated 8,541 mi of stream are adversely affected (impaired) by various physical changes or chemical contaminants to the point that criteria for at least one of the designated uses no longer can be met (Missouri Department of Natural Resources, 2008a).

The purpose of this report is to summarize ambient water-quality data collected cooperatively by the USGS and MDNR for water year 2008. Data on the physical characteristics and water-quality constituents in samples collected at 64 surface-water stations are presented in figures and tables. These 64 stations primarily were classified into groups corresponding to the physiography of the State, primary land use, or unique station types.

The Ambient Water-Quality Monitoring Network

The USGS, in cooperation with the MDNR, designed and operates the AWQMN, which is a series of monitoring stations on streams and springs throughout Missouri. Constituent concentration data from the AWQMN are used to determine statewide water-quality status and trends in order to meet information needs of State agencies involved in water-quality

Table 1. U.S. Geological Survey (USGS) station number, name, and sampling frequency of the 64 selected Ambient Water-Quality Monitoring Network (AWQMN) stations.

USGS station number	Station name	Water year 2008 sampling frequency
05495000	Fox River at Wayland	6
05500000	South Fabius River near Taylor	12
05587455	Mississippi River below Grafton, Ill.	12
06817700	Nodaway River near Graham	6
06818000	Missouri River at St. Joseph	12
06821190	Platte River at Sharps Station	6
06896187	Middle Fork Grand River near Grant City	6
06898100	Thompson River near Mt. Moriah	6
06898800	Weldon River at Princeton	6
06899580	No Creek near Dunlap	12
06899950	Medicine Creek at Harris	12
06900100	Little Medicine Creek near Harris	12
06900900	Locust Creek near Unionville	12
06902000	Grand River near Sumner	12
06905500	Chariton River near Prairie Hill	6
06905725	Musselfork near Mystic	12
06906300	East Fork Little Chariton River near Huntsville	6
06918070	Osage River above Schell City	6
06918600	Little Sac River near Walnut Grove	12
06921070	Pomme de Terre River near Polk	6
06921582	South Grand River below Freeman	6
06923700	Niangua River below Bennett Spring	6
06926510	Osage River below St. Thomas	6
06928440	Roubidoux Spring at Waynesville	6
06930450	Big Piney River at Devil's Elbow	6
06930800	Gasconade River above Jerome	12
[1]06934500	Missouri River at Hermann	15
07014000	Huzzah Creek near Steelville	6
07014200	Courtois Creek at Berryman	6
07014500	Meramec River near Sullivan	12
07016400	Bourbeuse River above Union	6
07018100	Big River near Richwoods	6
07019280	Meramec River at Paulina Hills	12
07021000	Castor River at Zalma	6
[1]07022000	Mississippi River at Thebes, Ill.	15
07036100	St. Francis River near Saco	6
07037300	Big Creek at Sam A. Baker State Park	6
07042450	St. Johns Ditch near Henderson Mound	6
07046250	Little River Ditches near Rives	12
07050150	Roaring River Spring near Cassville	12
07052152	Wilson Creek near Brookline	12
07052250	James River near Boaz	6
07052345	Finley Creek below Riverdale	12

Table 1. U.S. Geological Survey (USGS) station number, name, and sampling frequency of the 64 selected Ambient Water-Quality Monitoring Network (AWQMN) stations.—Continued

USGS station number	Station name	Water year 2008 sampling frequency
07052500	James River at Galena	12
07052820	Flat Creek below Jenkins	12
07053810	Bull Creek near Walnut Shade	12
07053900	Swan Creek near Swan	12
07054080	Beaver Creek at Bradleyville	12
07057500	North Fork River near Tecumseh	12
07057750	Bryant Creek below Evans	12
07061600	Black River below Annapolis	6
07066110	Jacks Fork above Two Rivers	6
07067500	Big Spring near Van Buren	4
07068000	Current River at Doniphan	12
07068510	Little Black River below Fairdealing	6
[1]07071000	Greer Spring at Greer	4
07071500	Eleven Point River near Bardley	6
07186480	Center Creek near Smithfield	9
07186600	Turkey Creek near Joplin	9
07188653	Big Sugar Creek near Powell	12
07188838	Little Sugar Creek near Pineville	12
07188885	Indian Creek near Lanagan	12
07189000	Elk River near Tiff City	12
07189100	Buffalo Creek at Tiff City	12

[1]Stations 06934500, 07022000, and 07071000 are not part of the AWQMN, but were used in the report. Stations 06934500 and 07022000 are funded by the U.S. Geological Survey National Stream Quality Accounting Network; 07071000 is funded by the U.S. Forest Service.

planning and management. The data collected provides support for the design, implementation, and evaluation of preventive and remediation programs.

The objectives of the AWQMN are (1) to obtain data on the quality and quantity of surface water within the State; (2) provide a historical database of water-quality information that can be used by the State planning and management agencies to make informed decisions about anthropogenic effects (agriculture, mining, urban, etc.) on the State's surface waters; and (3) provide for consistent methodology in data collection, laboratory analysis, and data reporting.

The MDNR and the USGS have maintained a fixed-station AWQMN in Missouri since 1964. During the 2008 water year, the program consisted of 67 stations, including two USGS National Stream Quality Accounting Network (NASQAN; a national water-quality sampling network operated by the USGS) stations and one spring sampled in cooperation with the U.S. Forest Service. From these 67 stations, 64 are included in this report. Three stations did not fit in the groups (classes) defined for this report, and they were not included. The three excluded stations were Cuivre River near Troy (05514500) and Lamine River near Pilot Grove (06907300) located in the Ozark Plateaus border, and Lake Taneycomo at Branson (07053700). Sampling frequency (table 1) is determined by a number of factors, including drainage basin size, potential effects from anthropogenic activity, history of chemical change, need for short-term data, and cost. Each of the streams in the AWQMN is classified for one or more designated uses. For specific information on the designated uses applicable to the stations in the AWQMN, refer to Missouri Department of Natural Resources (2008b).

The unique 8-digit number used by the USGS to identify each surface-water station is assigned when a station is first established. The complete 8-digit number for each station includes a two-digit prefix that designates the major river system (05 is the Upper Mississippi River, 06 is the Missouri River, and 07 is the Lower Mississippi River) plus a 6-digit downstream-order number. For example, the station number 05587455 indicates the station is located on the Upper Mississippi River (05) while the remaining six digits (587455) locate the site in downstream order. In this system, the station numbers increase downstream along the mainstem. A station on a tributary that enters between two mainstem stations is assigned a station number between them.

Methods used for collecting and processing representative water-quality samples are presented in detail in the USGS National Field Manual for the Collection of Water-Quality Data (U.S. Geological Survey, variously dated). Onsite measurements of dissolved oxygen (DO), specific conductance, and water temperature were made at each station according to procedures described in Wilde (chapter sections variously dated). Samples were collected and analyzed for indicator bacteria [fecal coliform and *Escherichia coli (E. coli)*] using the membrane filtration procedure described in Myers and others (2007). Methods used by the USGS for collecting and processing representative samples for nutrient, major chemical constituent, trace element, suspended solids, suspended sediment, and pesticide analysis are presented in detail in U.S. Geological Survey (2006), Guy (1969), and Wilde and others (2004). All chemical analyses were done by the USGS National Water Quality Laboratory (NWQL) in Lakewood, Colorado, according to procedures described in Fishman and Friedman (1989), Fishman (1993), and Zaugg and others (1995).

Laboratory Reporting Conventions

The NWQL uses method reporting conventions (Childress and others, 1999) for establishing the minimum concentration above which a quantitative measurement could be made. These reporting conventions are the method reporting level (MRL) and the laboratory reporting level (LRL). The MRL is defined by the NWQL as the smallest measured concentration of a substance that can be measured reliably using a given analytical method. The method detection level (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the concentration is greater than zero. A long-term method detection limit (LT-MDL) is a detection level obtained by determining the standard deviation of 20 or more MDL spiked-sample measurements conducted over an extended period of time. The LRL is computed as twice the LT-MDL. In boxplots (box and whiskers distributions), concentration values reported less than the MRL, less than the LRL, or as “E” (estimated to be below the MRL or LRL) were included in each distribution as a concentration value equal to the MRL or LRL, depending on the constituent reporting convention.

Data Analysis Methods

The distribution of selected constituent data was graphically displayed using side-by-side boxplots (Helsel and Hirsch, 2002, p. 24–26). The plots show the center of the data (median, the center line of the boxplot), the variation [interquartile range (25th to 75th percentiles) or the height of the box], the skewness (quartile skew, which is the relative size of the box halves), the spread (upper and lower adjacent values are the vertical lines or whiskers), and the presence or absence of unusual values, or outliers (upper and lower detached and outside values). If the median equals the 25th and 75th percentiles, the boxplot is represented by a single horizontal line. Boxplots constructed for sites with censored data (data reported less than some threshold) were modified by making the lower limit of the box equal to the MRL or LRL.

Station Classification for Data Analysis

The stations primarily were classified in groups corresponding to the physiography of the State (fig. 2), primary land use (fig. 3), or unique station types (fig. 1; table 2). The physiography-based groups include the Plains (PLAINS) in the north and west, the Mississippi Alluvial Plain (MIALPL) in the southeast, and between them the Ozark Plateaus. The Ozark Plateaus (Fenneman, 1938) were further subdivided into two distinct sections based on physiographic location — the Salem Plateau Section (OZPLSA) and the Springfield Plateau Section (OZPLSP). Land-use groups include mining (MINING) and urban (URBAN) stations, whereas unique station classes refer to springs (SPRING) and the stations located on the big rivers [the Mississippi River (BRMIG and BRMIT) and the Missouri River (BRMOS and BRMOH)].

Some additional variability caused by differences in drainage area and land use was observed within physiographic regions; therefore, watershed size and land-use indicators were employed to develop a complete set of classes. The land-use indicator provides a subclassification for stations in similar regions with different land uses (fig. 1; table 2). The secondary land-use indicators are watershed indicator stations (wi), which are the most downstream stations in a large watershed; forest (fo); and agricultural (ag). Observations and analyses from watershed indicator stations can be interpreted as being representative of the general condition of the watershed. In some instances, both the agricultural and forest secondary land uses were present; therefore, the convention was to mention them in predominant order. For example, an agriculture and forest (ag/fo) indicator implies that the primary land use of the watershed is agriculture, although a substantial fraction of it is forest.

Summary of Hydrologic Conditions

Surface-water streamflow varies seasonally in Missouri and tends to reflect precipitation patterns. Six continuous streamflow gaging stations (hereafter referred to as gaging station) across the State were selected to illustrate the 2008 water year monthly mean discharge and the long-term median of monthly mean discharge (fig. 4). The selection of these gaging stations was based on their geographical distribution across the State and their long period of record. Of these six stations,

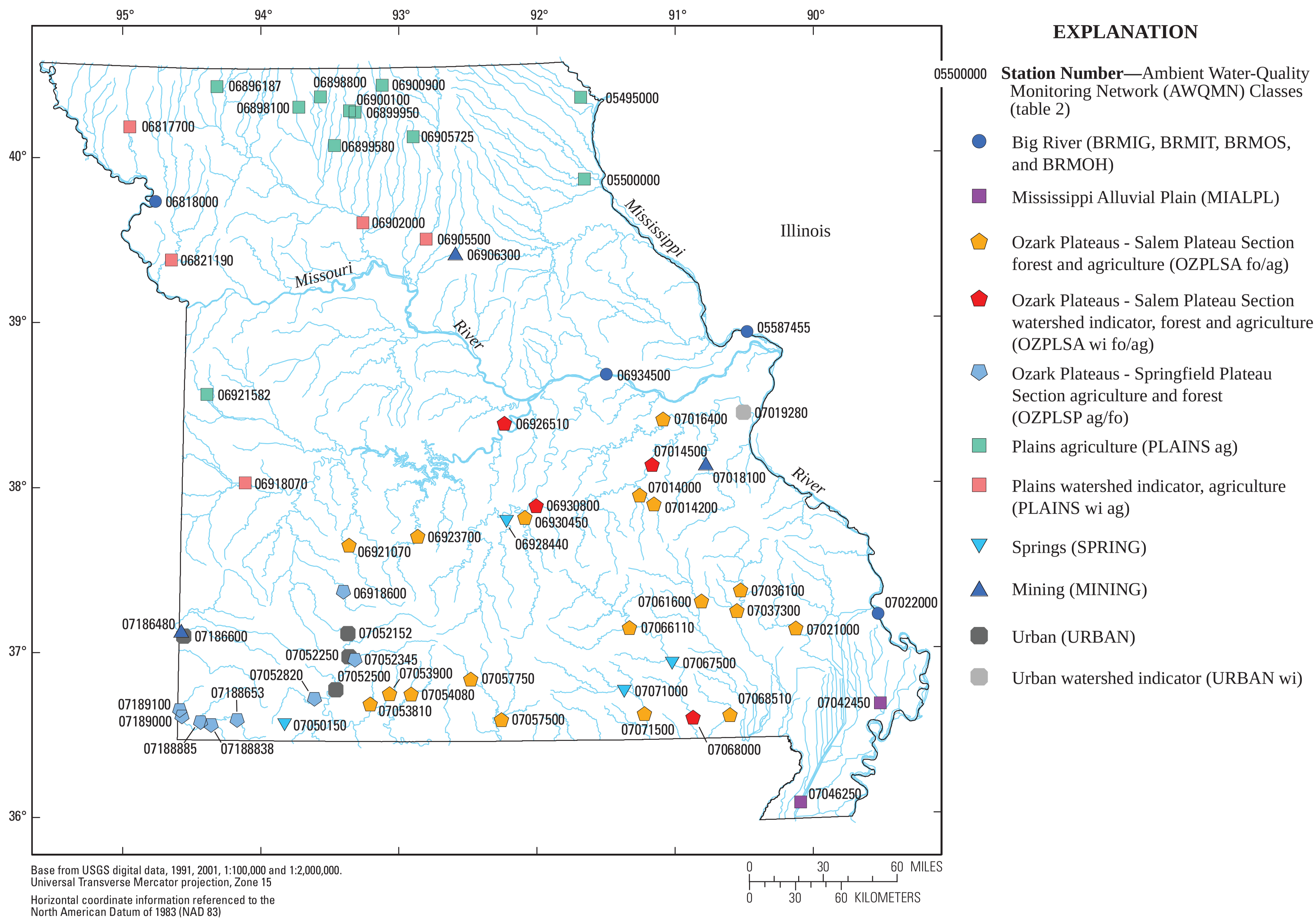


Figure 1. Location and class of selected Ambient Water-Quality Monitoring Network (AWQMN) stations, Missouri, water year 2008.

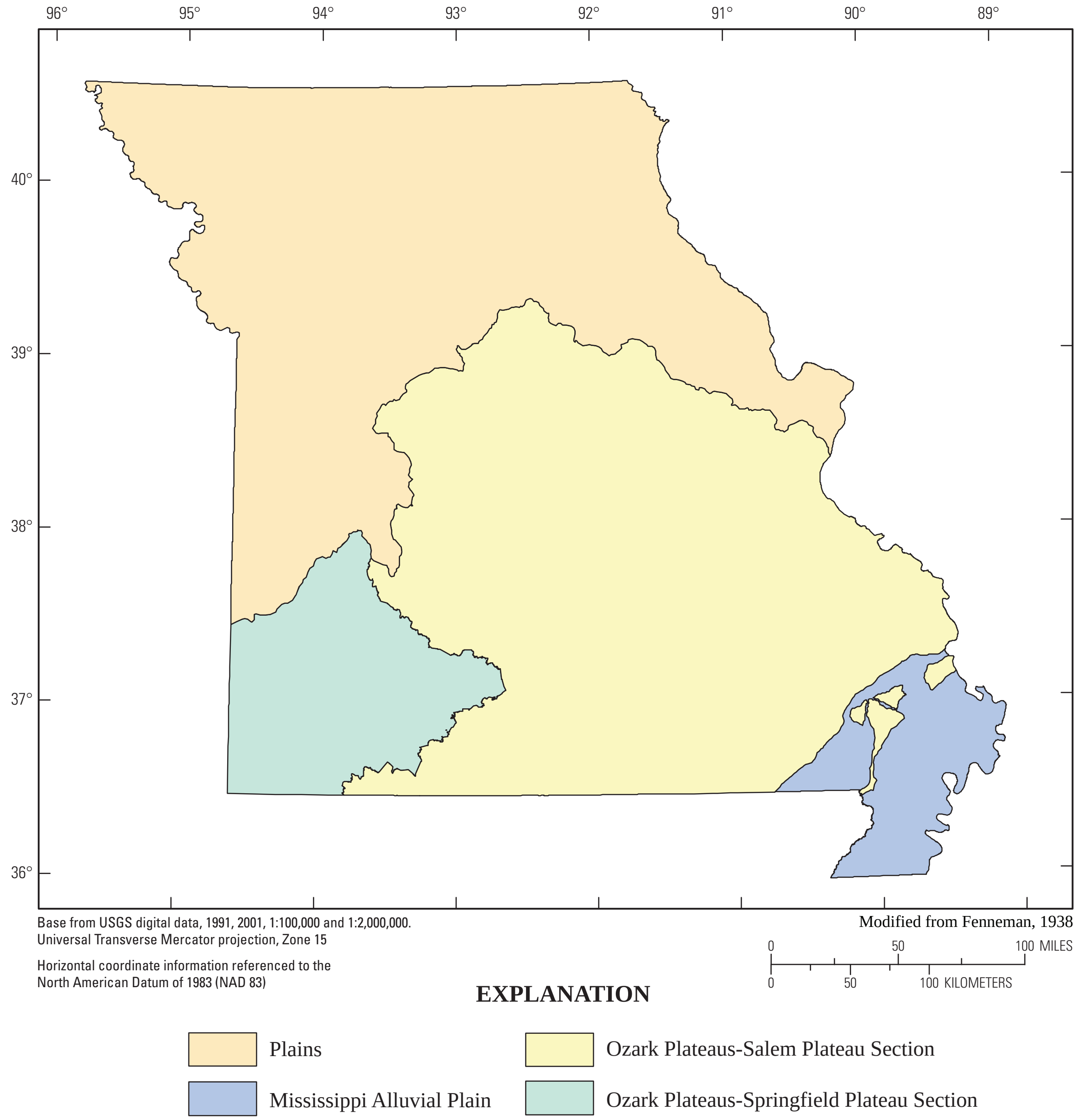


Figure 2 Physiographic regions of Missouri.

two (05495000 and 07052500) are part of the AWQMN, one (06934500) is a NASQAN station, and the remaining three (06897500, 06933500, and 07067000) are gaging stations only and are not part of the AWQMN.

During the 2008 water year, precipitation in the United States was variable throughout much of the country, with periods of excessive rainfall, especially across the central one-third of the country. Missouri experienced its wettest year on record with 57.28 inches (in.) of total precipitation, which was 16.52 in. above average (National Oceanic and Atmospheric Administration, 2009). The above average precipitation for 2008 is reflected in figure 4, where all the gaging stations show monthly mean discharge consistently above the median of the monthly mean discharge for the period of record. The largest differences can be observed at stations 05495000 (Fox River at Wayland), 06897500 (Grand River near Gallatin), and 07052500 (James River at Galena) (fig. 4).

Peak discharges for the 2008 water year and for the period of record are presented for nine gaging stations (table 3) selected for their geographical distribution across the State and their long period of record. Because water-quality standards are based on low-flow conditions, the seven-day low flow for the 2008 water year, the seven-day low flow for the period of record, and the minimum daily mean flow are presented for selected stations in table 4.

Table 2. Station classification system.

Class (fig. 1)	Description	Number of stations
BRMIG	Big River – Mississippi River at Grafton	1
BRMIT	Big River – Mississippi River at Thebes	1
BRMOS	Big River – Missouri River at St. Joseph	1
BRMOH	Big River – Missouri River at Hermann	1
MIALPL	Mississippi Alluvial Plain	2
OZPLSA fo/ag	Ozark Plateaus – Salem Plateau Section forest and agriculture	18
OZPLSA wi fo/ag	Ozark Plateaus – Salem Plateau Section watershed indicator, forest and agriculture	4
OZPLSP ag/fo	Ozark Plateaus – Springfield Plateau Section agriculture and forest	8
PLAINS ag	Plains agriculture	11
PLAINS wi ag	Plains watershed indicator, agriculture	5
SPRING	Springs	4
MINING	Mining	3
URBAN	Urban	4
URBAN wi	Urban watershed indicator	1

Distribution, Concentration, and Detection Frequency of Selected Constituents

The analyses presented in this report include the following constituents: DO, specific conductance, water temperature, suspended solids, suspended sediment, fecal coliform bacteria, *E. coli* bacteria, dissolved nitrate plus nitrite, total phosphorus, and dissolved and total recoverable lead and zinc. In addition, select pesticide data were analyzed from seven stations in the AWQMN. The following pesticides were selected for presentation in this report: 2-chloro-4-isopropylamino-6-amino-s-triazine (CIAT; a degradation product of atrazine), acetochlor, alachlor, atrazine, metolachlor, metribuzin, molinate, prometon, and simazine. The selection of these constituents and pesticides for presentation in this report was based on: (1) values or concentrations of the selected constituents are characteristic of stream-water quality in the different physiographic areas and occur because of natural causes, and (2) values and concentrations of the selected constituents and pesticides are above background concentrations. Boxplots of measured constituents are presented for the different classes (figs. 5–7). Pesticide data are presented in figure 8. Missouri water-quality standards are not shown on the graphs because these standards are not applicable to all streams in the AWQMN network. For specific information on Missouri water-quality standards, refer to Missouri Department of Natural Resources (2008b).

Distribution of Physical Properties, Suspended Solids, Suspended Sediment, and Indicator Bacteria

The physical properties analyzed for this report were DO, specific conductance, and water temperature. The median DO, in percent saturation, was similar for all station classes, ranging from 76 to 103 milligrams per liter (mg/L). Samples from URBAN stations had the highest median DO percent saturation values, whereas samples from MIALPL stations had the lowest (fig. 5). Median specific conductance values varied substantially among the station classes (fig. 5), ranging from 257 to 715 microsiemens per centimeter at 25 degrees Celsius. The largest median specific conductance values were measured at the Big River and URBAN stations, with the largest median value at BRMOS. MIALPL had the smallest median specific conductance value. Median water temperature values also were similar for all station classes, ranging from 11.3 to 17.1 degrees Celsius (ºC). The range in water temperature at SPRING stations was much smaller than at any other station class.

Suspended solids and suspended sediment are measures of the solid material suspended in the water column. These two measures are not considered directly comparable because of differences in collection and analytical techniques. Suspended-sediment concentrations were determined only at the four Big River stations and one station in the OZPLSA fo/ag class; suspended-solids concentrations were determined at all other stations except for those included in the BRMIT

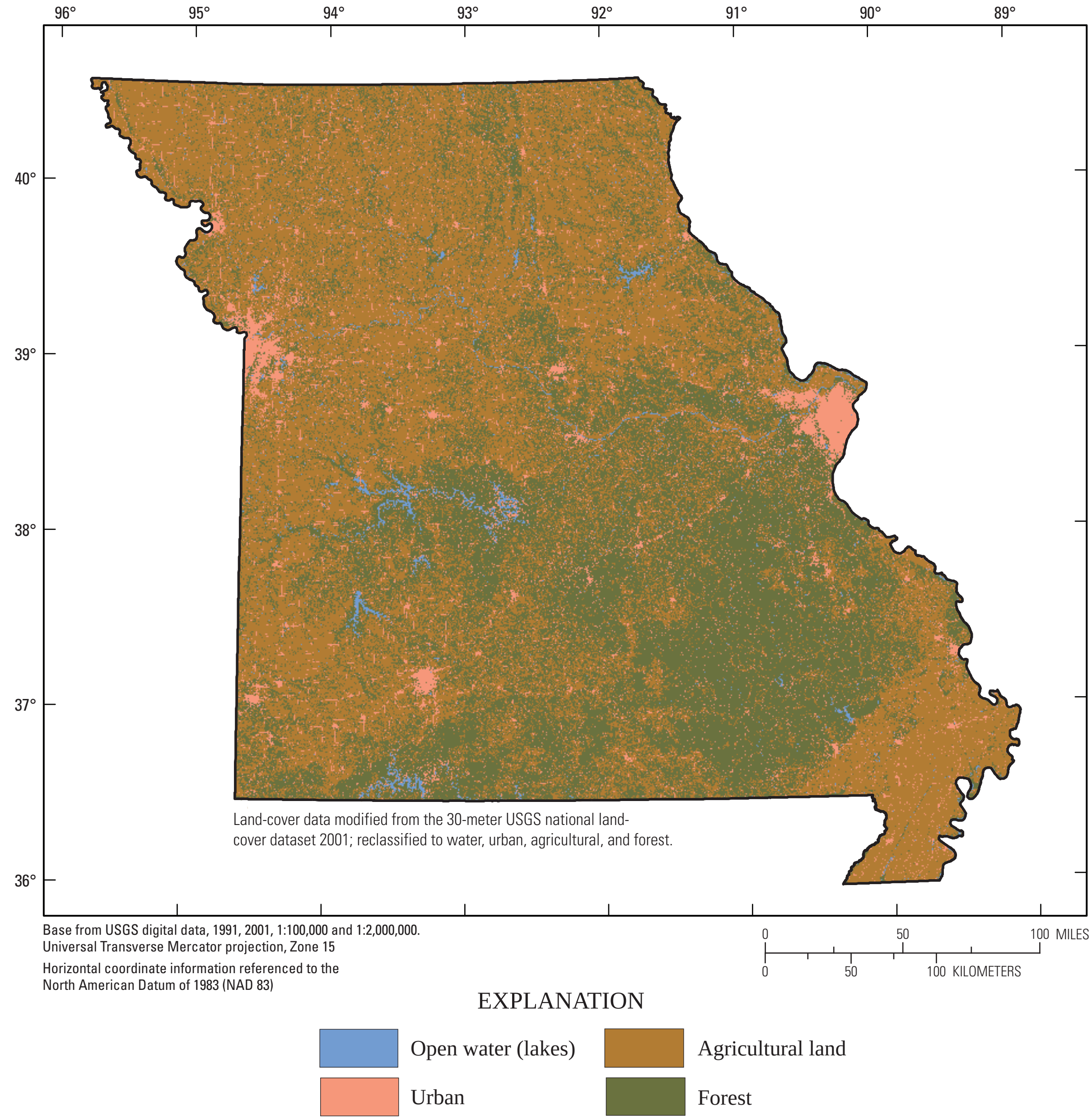


Figure 3. Land use of Missouri.

and BRMOH classes. Median suspended-solids concentrations varied considerably between all station classes, ranging from less than 10 to 362 mg/L. Samples collected at BRMIG, BRMOS, and PLAINS wi ag stations had the largest median suspended-solids concentrations, whereas samples collected at all OZPL (SA fo/ag, SA wi fo/ag, and SP ag/fo), SPRING, MINING, and URBAN stations all had median concentrations less than the MRL. Median suspended-sediment concentrations ranged from 143 to 600 mg/L at the four Big River stations. These concentrations were substantially larger than the only measured concentration of 2 mg/L at the OZPLSA fo/ag station (fig. 5).

Median fecal coliform and *E. coli* bacteria densities varied considerably between all station classes. Median fecal coliform bacteria densities (fig. 5) ranged from 39 to 470 colonies per 100 milliliters (col/100mL). The largest median densities were in samples collected at BRMOH, PLAINS ag, and PLAINS wi ag stations; the smallest median densities were measured at BRMIG, OZPLSA (fo/ag and wi fo/ag), and SPRING stations. Median *E. coli* bacteria densities ranged from 18 to 460 col/100mL (fig. 5). The largest median densities were in samples collected at BRMOH, PLAINS ag, and PLAINS wi ag stations, whereas the lowest median densities were in samples collected at OZPLSA wi fo/ag stations (fig. 5).

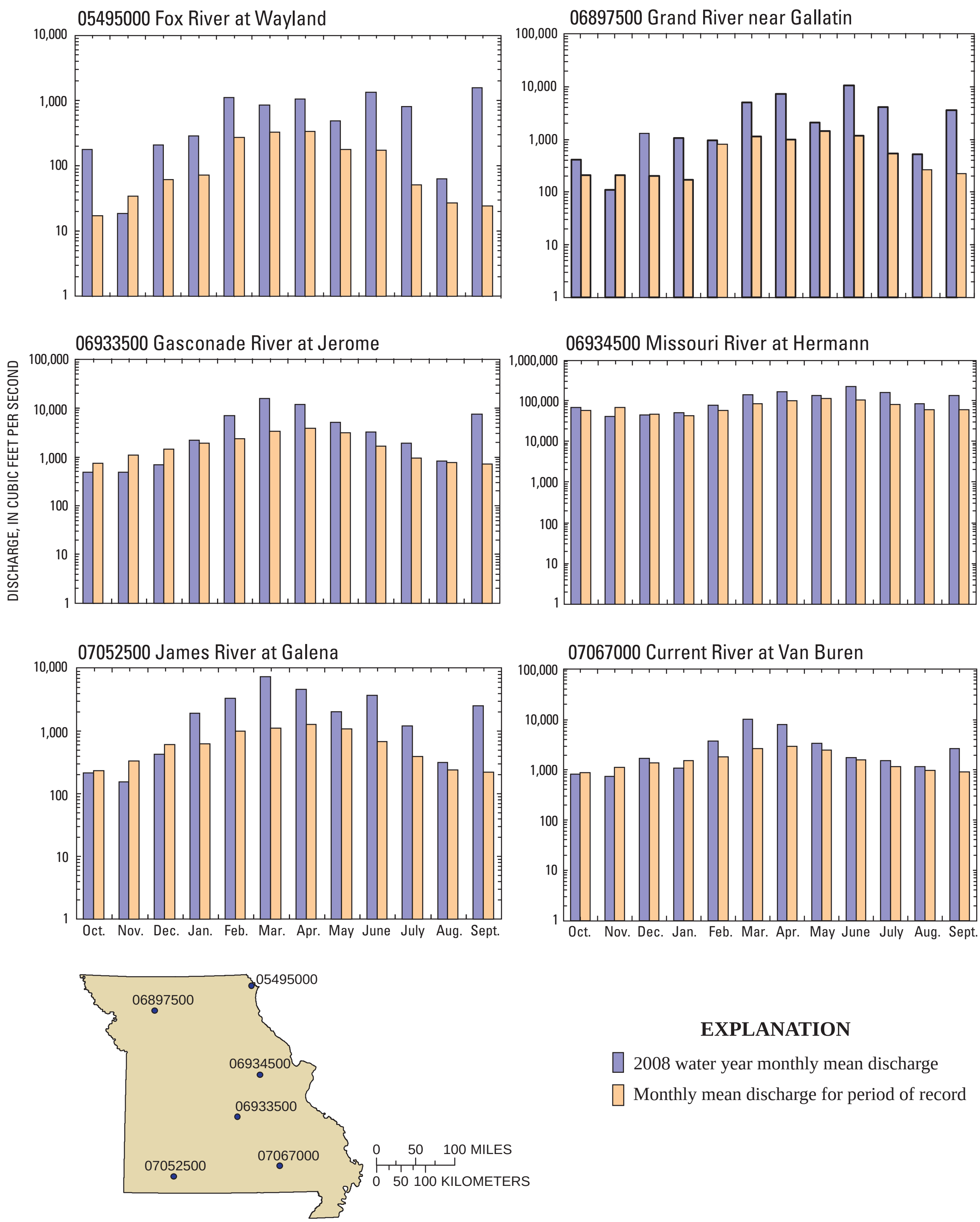


Figure 4. 2008 water year monthly mean discharge and long-term median of monthly mean discharges at six representative streamflow gaging stations.

Table 3. Peak discharge for the 2008 water year and period of record for selected stations.

U.S. Geological Survey station Identifier[1]	Station name (period of record in water years)	Peak discharge during 2008 water year		Peak discharge for long-term period of record	
		Cubic feet per second	Date	Cubic feet per second	Date
05495000	Fox River at Wayland (1922–2008)	16,300	Sept. 15	26,400	Apr. 22, 1973
05587450	Mississippi River at Grafton, Ill. (1928–2008)	439,000	June 28	598,000	Aug. 1, 1993
06905500	Chariton River near Prairie Hill (1929–2008)	37,700	July 27	37,700	July 27, 2008
06933500	Gasconade River at Jerome (1923–2008)	104,000	Mar. 20	136,000	Dec. 5, 1982
06934500	Missouri River at Hermann (1898–2008)	338,000	Sept. 16	750,000	July 31, 1993
07019000	Meramec River near Eureka (1922–2008)	115,000	Mar. 21	145,000	Dec. 6, 1982
07022000	Mississippi River at Thebes, Ill. (1933–2008)	710,000	July 2	996,000	Aug. 7, 1993
07057500	North Fork River near Tecumseh (1945–2008)	37,400	Mar. 19	133,000	Nov. 19, 1985
07068000	Current River at Doniphan (1919–2008)	88,700	Mar. 20	122,000	Dec. 3, 1982

[1]Stations 05587450, 06933500, and 07019000 are streamflow gaging stations only and not part of the Ambient Water-Quality Monitoring Network (AWQMN).

Table 4. Seven-day low flow for water year 2008, period of record seven-day low flow, and period of record minimum daily mean flow for selected stations.

[flow in cubic feet per second]

U.S. Geological Survey station number[1]	Station name (period of record in water years)	Seven-day low flow		Minimum daily mean flow for period of record	
		2008	Period of Record	Discharge	Date
05495000	Fox River at Wayland (1922–2008)	0.14	0	0	Several years
06820500	Platte River near Agency (1933–2008)	53	0	0	Several years
06921070	Pomme de Terre river near Polk (1969–2008)	15	.34	.3	Aug. 10, 1980
07016500	Bourbeuse River near Union (1921–2008)	33	13	12	Oct. 10, 1956
07067000	Current River at Van Buren (1912–2008)	723	479	476	Oct. 7, 1956
07187000	Shoal Creek above Joplin (1942–2008)	108	16	15	Sept. 7, 1954

[1]Stations 06820500, 07016500, 07067000 and 07187000 are streamflow gaging stations only and not part of the Ambient Water-Quality Monitoring Network (AWQMN).

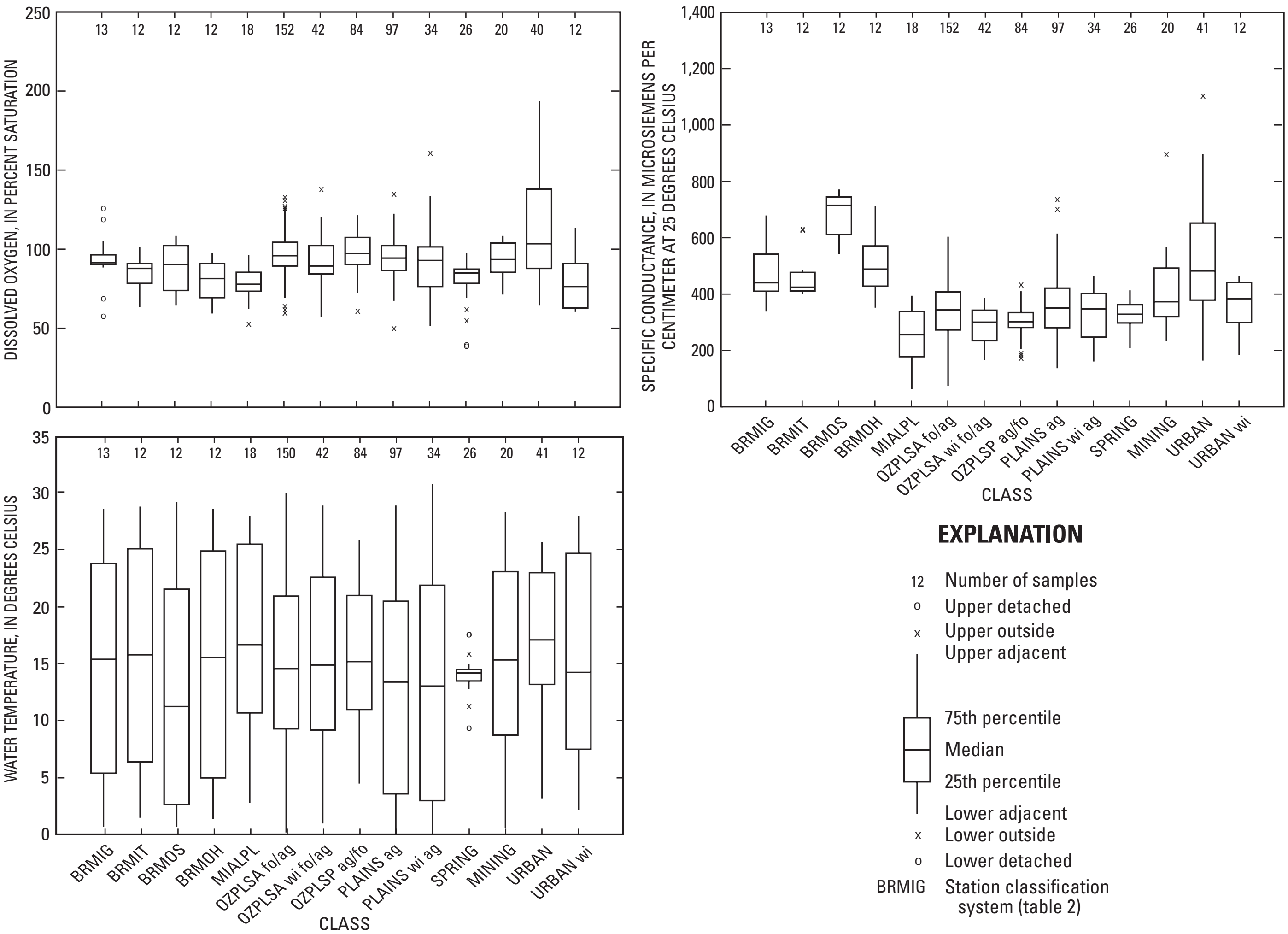


Figure 5. Distribution of physical properties, suspended solids, suspended sediment, and indicator bacteria densities in samples from 64 stations in the Ambient Water-Quality Monitoring Network (AWQMN), water year 2008.

Distribution and Concentration of Dissolved Nitrate plus Nitrite and Total Phosphorus

Samples were collected at all stations for the analysis of nutrients, including dissolved nitrate plus nitrite and total phosphorus. Median dissolved nitrate plus nitrite and total phosphorus concentrations varied considerably between all station classes (fig. 6), ranging from 0.23 to 3.4 mg/L nitrate plus nitrite as nitrogen and from less than 0.04 to 0.50 mg/L total phosphorus as phosphorus. The largest median dissolved nitrate plus nitrite concentrations were detected in samples collected at all Big River (BRMIG having the largest median concentration), OZPLSP ag/fo, and URBAN stations; with the smallest being detected at MIALPL, OZPLSA fo/ag, OZPLSA wi fo/ag, and URBAN wi stations (fig. 6). Similarly, median total phosphorus concentrations also were among the largest at the Big River (BRMOH having the largest median concentration of the Big River stations), MIALPL, and PLAINS (ag and wi ag) stations. The largest median total phosphorus concentration was detected at the PLAINS wi ag stations (fig. 6).

Distribution and Concentration of Dissolved and Total Recoverable Lead and Zinc

Samples were collected for the analysis of dissolved and total recoverable trace elements, including lead and zinc. No total recoverable lead and zinc samples were collected at BRMIT and BRMOH. Median concentration ranges of dissolved and total recoverable lead and zinc (fig. 7) were dissolved lead, less than 0.08 to 0.37 micrograms per liter (µg/L); total recoverable lead, 0.08 to 13 µg/L; dissolved zinc, less than 1.8 to 70 µg/L; and total recoverable zinc, less than 2 to 98 µg/L. The largest median concentrations for all four constituents generally were detected in samples collected at MINING, URBAN, and URBAN wi stations. The smallest median concentrations of dissolved and total recoverable lead and zinc generally were detected in samples collected at all OZPLSA (fo/ag and wi fo/ag), OZPLSP ag/fo and SPRING stations (fig. 7).

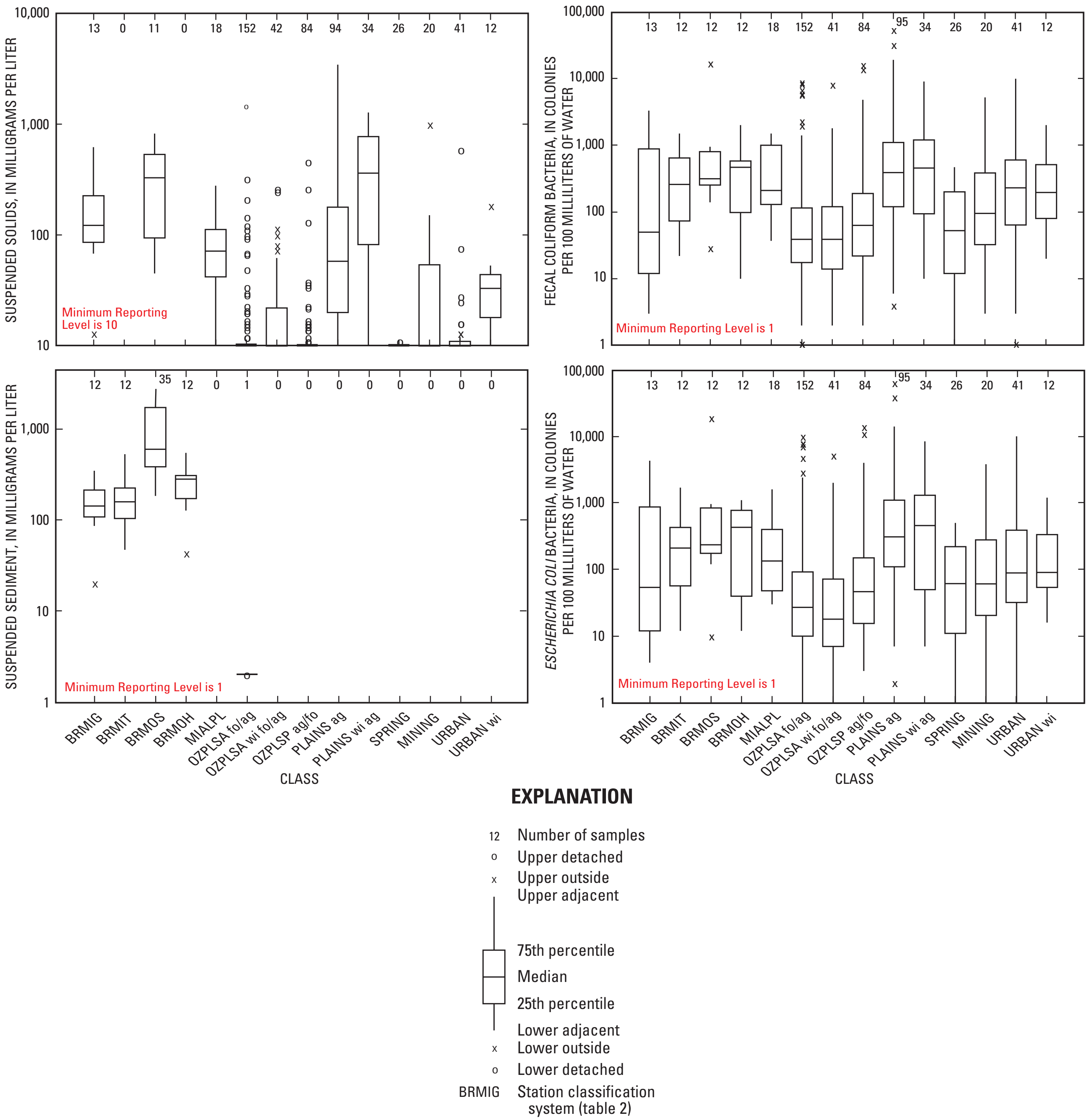


Figure 5. Distribution of physical properties, suspended solids, suspended sediment, and indicator bacteria densities in samples from 64 stations in the Ambient Water-Quality Monitoring Network (AWQMN), water year 2008.—Continued

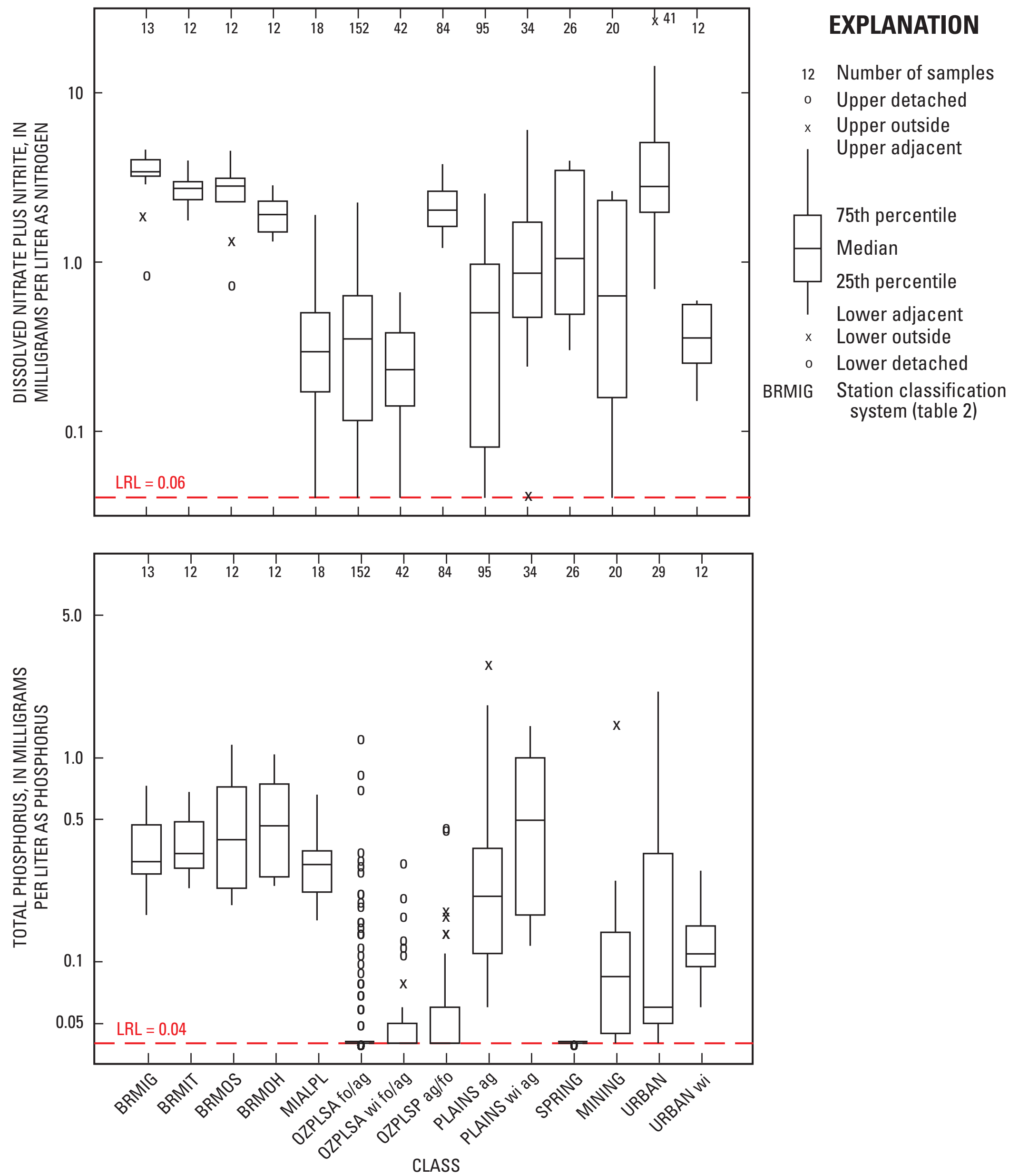


Figure 6. Distribution of dissolved nitrate plus nitrite and total phosphorus concentrations in samples from 64 stations in the Ambient Water-Quality Monitoring Network (AWQMN), water year 2008.

Concentration and Detection Frequency of Selected Pesticides from Selected Stations

Samples for the analysis of dissolved pesticides were collected at seven stations in the AWQMN, including three of the four Big River stations (BRMIG, BRMIT, and BRMOH), both stations in the MIALPL, one station in the PLAINS wi ag, and one SPRING station. The nine compounds that were detected are presented in this report (fig. 8). The most frequently detected pesticides were acetochlor, atrazine, and metolachlor, followed closely by CIAT and simazine. The concentrations detected for all pesticides, except atrazine, generally were near or less than 2.00 µg/L at all the stations. The concentrations detected for atrazine ranged from 0.001 to 7.80 µg/L. At the SPRING stations, only CIAT and atrazine were detected in concentrations estimated less than the LRL.

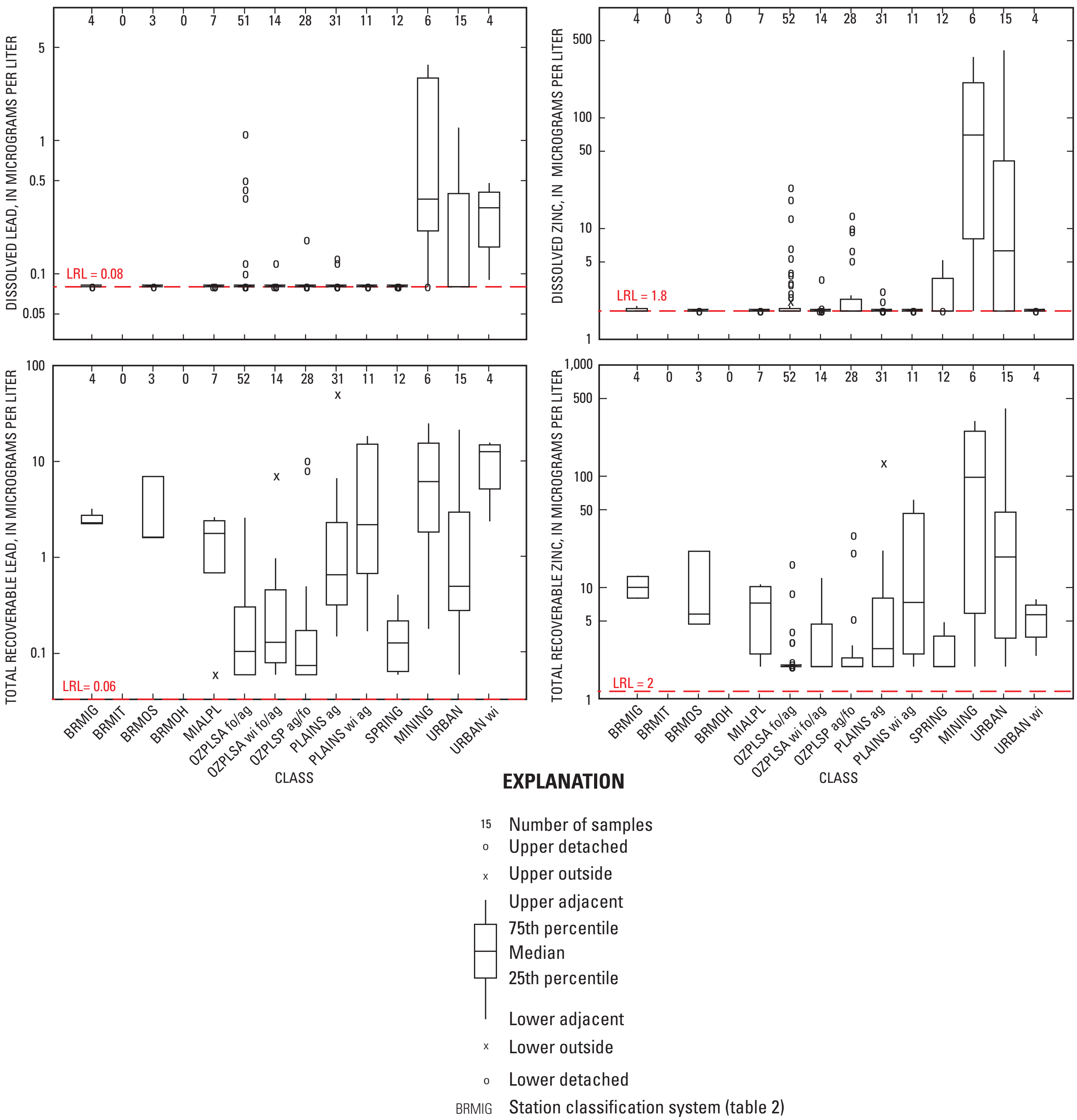


Figure 7. Distribution of dissolved and total recoverable lead and zinc concentrations in samples from 64 stations in the Ambient Water-Quality Monitoring Network (AWQMN), water year 2008.

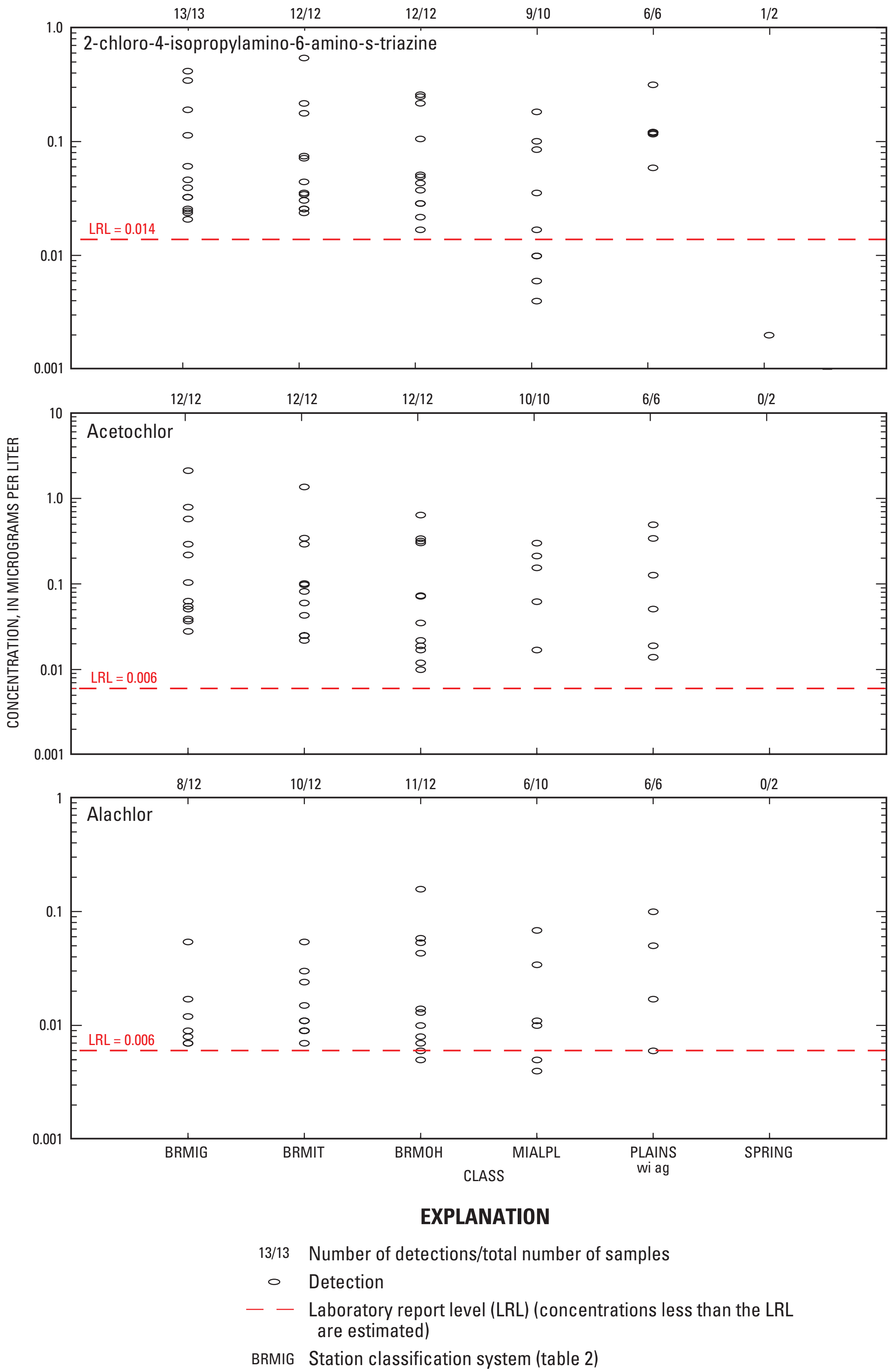
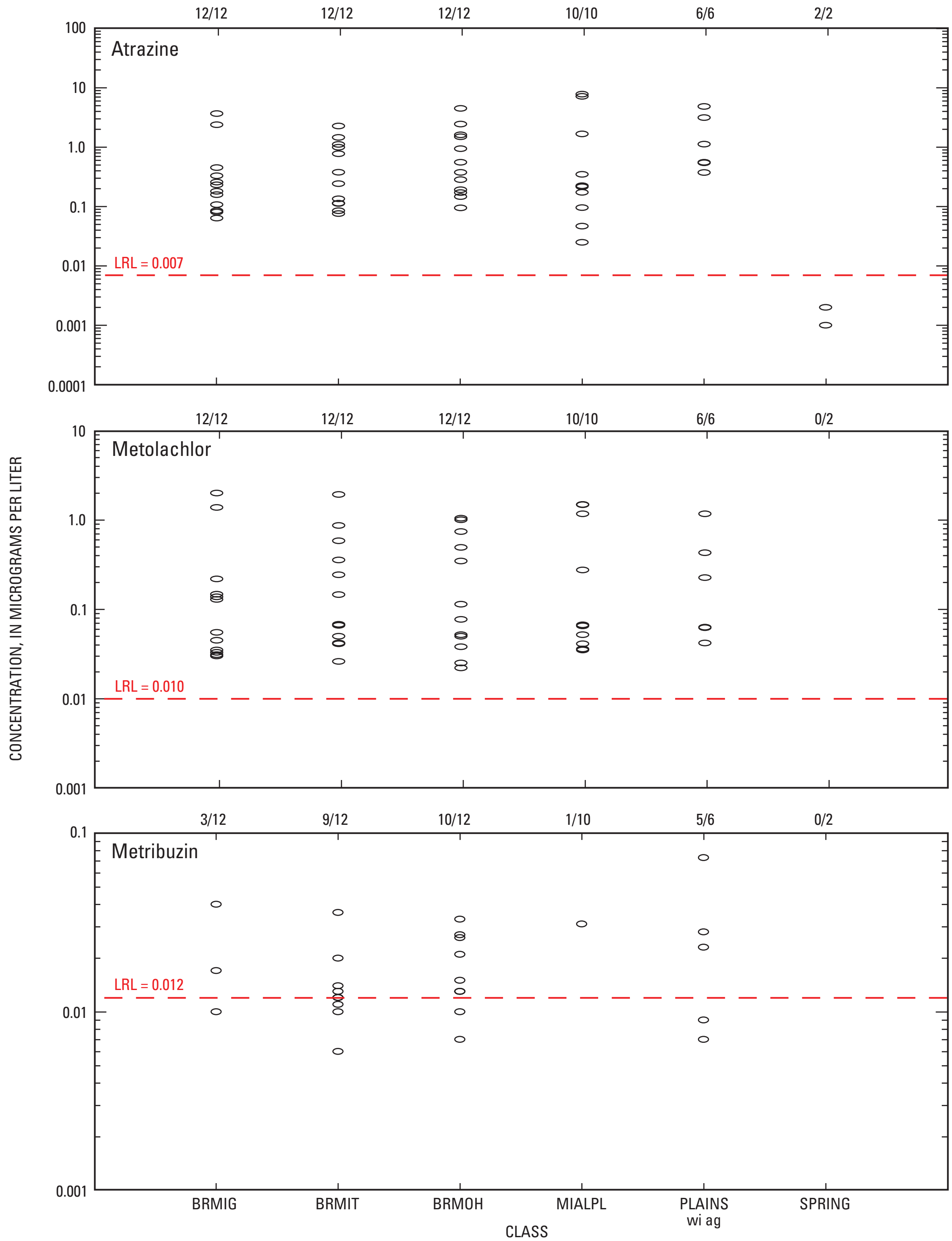


Figure 8. Detection of selected pesticides from selected stations in the Ambient Water-Quality Monitoring Network (AWQMN), water year 2008.



EXPLANATION

13/13 Number of detections/total number of samples

Detection

Laboratory report level (LRL) (concentrations less than the LRL are estimated)

BRMIG Station classification system (table 2)

Figure 8. Detection of selected pesticides from selected stations in the Ambient Water-Quality Monitoring Network (AWQMN), water year 2008.—Continued

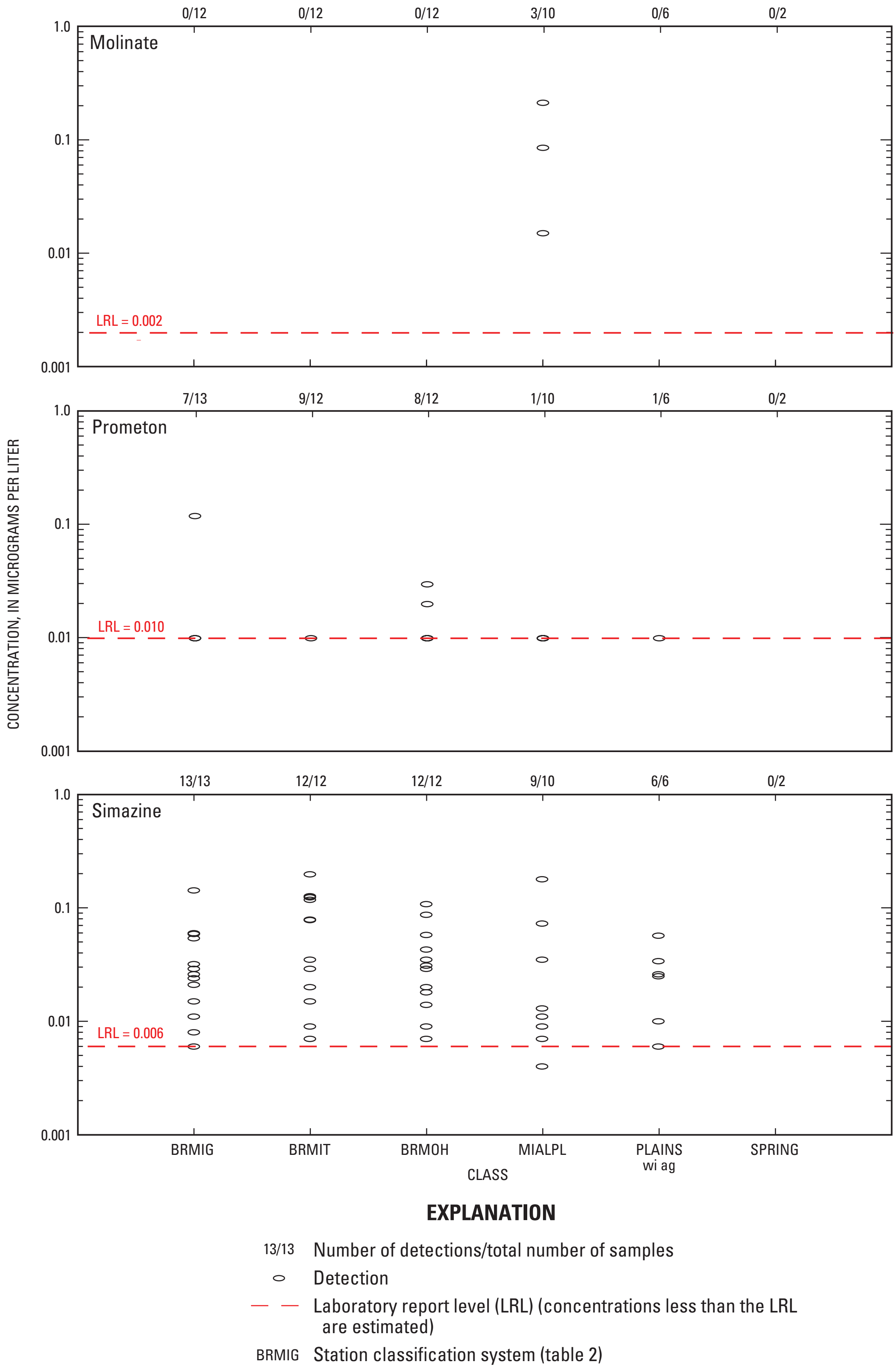


Figure 8. Detection of selected pesticides from selected stations in the Ambient Water-Quality Monitoring Network (AWQMN), water year 2008.—Continued

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Missouri Water Science Center
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